

WATER POSSIBILITIES FROM THE  
GLACIAL DRIFT OF  
SULLIVAN COUNTY

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Water Resources Report 10

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OF SULLIVAN COUNTY

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MISSOURI GEOLOGICAL SURVEY AND WATER RESOURCES ROLLA, MO.

William C. Hayes, State Geologist and Director

WATER POSSIBILITIES FROM THE GLACIAL DRIFT  
OF SULLIVAN COUNTY

A special study of groundwater by the Missouri Geological Survey and Water Resources was made possible at the 1955 session of the Missouri Legislature. With the approval of the Governor, money was appropriated from the Missouri Post War Surplus Reserve Fund.

Since nearly two-thirds of the counties located north of the Missouri River are deficient in water supplies, much of the effort of this special study is being directed toward the problems of this area.

It has been shown that a program of test drilling can locate new reserves of groundwater. Potential areas are being tested so that additional supplies will be available for domestic, irrigation, industrial and municipal needs.

The most favorable areas are in the sand and gravel filled channels and valleys of pre-glacial and inter-glacial streams. Since these buried valleys do not conform to present day drainage patterns, a systematic program of test drilling is a principal means of locating the channels and mapping their extent. Such glacial deposits have proved to be excellent sources of groundwater.

QUALITY OF WATER FROM ROCK WELLS

The water from the consolidated rock formations which underlie Sullivan County is, for the most part, mineralized. The following are analyses from water wells and prospect holes.

CONSTITUENTS	IN PARTS PER MILLION		
	A	B	C
Turbidity	12	Turbid	6
Odor	none	none	none
pH	8.4		8.2
Alkalinity (CaCO <sub>3</sub> )	357.5	416.5	148.5
Phenolphthalein	22.0		6.0
Methyl Orange	335.5		142.5
Carbonate (CO <sub>3</sub> )	13.2	0.0	3.6
Bicarbonate (HCO <sub>3</sub> )	409.3	507.9	173.9
Silica (SiO <sub>2</sub> )	8.7	17.2	10.7
Oxides (Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> , TiO <sub>2</sub> , etc.)	3.3	0.66*	2.3
Calcium (Ca)	71.7	122.0	253.0
Magnesium (Mg)	31.1	87.6	106.6
Sodium (Na) and Potassium (K) as Na	694.0	166.5	531.9
Total Manganese (Mn)	0.00	0.03	0.00
Total Iron (Fe)	2.22	2.10	2.44
Dissolved Iron	0.86	0.10	0.08
Precipitated Iron	1.36	2.00	2.36
Sulfate (SO <sub>4</sub> )	1281.5	415.8	1973.7
Chloride (Cl)	132.5	87.1	23.0
Nitrate (NO <sub>3</sub> )	0.1	0.84	2.9
Fluoride (F)	1.4	0.6	1.0
Total Suspended Matter	12.	20.4	34.
Total Dissolved Solids	2463.	1254.0	3175.
Total Hardness	307.1	664.2	1070.5
Carbonate Hardness	357.5	416.5	148.5
Non-carbonate Hardness	0.0		922.0
Percent of Alkalies	83	35	52

\* Al<sub>2</sub>O<sub>3</sub> only

A. Owner: Vergil L. Lehr, SW<sub>1/4</sub> SW<sub>1/4</sub> NE<sub>1/4</sub> sec. 29, T. 63N, R. 19W. Total depth 540 feet. Sampled January 16, 1957 after passing through the pressure tank. Analyst: M. E. Phillips.

B. Owner: Guy Head, SE<sub>1/4</sub> SE<sub>1/4</sub> sec. 28, T. 61N., R. 20W. Total depth 167 feet, 10 inches. Prospect hole for coal. During dry weather of 1934 the well supplied as much as 45,000 gallons of water per day. Probable source of water "Pennsylvanian, probably Henrietta or Upper Cherokee." Analyzed January 14, 1935 by R. T. Rolufs.

C. Owner: Arthur C. Morris, SW<sub>1/4</sub> SW<sub>1/4</sub> NW<sub>1/4</sub> sec. 15, T. 61N., R. 19W. Total depth 420 feet. Drilled 1912 - 1913. Static water level 100 feet. Sample from storage reservoir January 16, 1957. Analyst: M. E. Phillips.

Referring to Plate 1, it will be noted that a large area of Sullivan County is unfavorably located to obtain water from glacial drift. Wells drilled into the consolidated rock to moderate depths may possibly obtain limited yields of water of marginal quality. The water from "rock" wells in all probabilities will become more mineralized with increased depth of drilling.

#### QUALITY AND QUANTITY OF WATER FROM STREAMS

The streams of Sullivan County, are intermittent in their flow. Though the quality of the water is usually satisfactory, the undependable flow makes all streams unsuitable for irrigation or for municipal use.

The following are stream flow data from: Bolon, Harry C., Surface Waters of Missouri; Missouri Geological Survey and Water Resources, 2d ser., vol. 34, p. 368, 1952.

##### Locust Creek Near Milan

Location: Chain gage in SW $\frac{1}{4}$  sec. 8, T. 62N., R. 20W., at bridge on State Highway 6, 3 $\frac{1}{2}$  miles southwest of Milan.

Drainage Area -- 225 square miles.

Records Available -- July 1921 to September 1933 (discontinued).

Average discharge -- 12 years, 152 second-feet.\*

Extremes -- 1921-33: Maximum discharge, 3880 second-feet November 18, 1928 (gage height, 20.07 feet); minimum, 0.1 second-foot August 8, 1930.

Revisions -- Revised figures of discharge for the water year 1925, superseding those published in "Water Resources of Missouri, 1857-1926," Vol. XX, Second Series, are given herein.

\* One second-foot equals 448.83 gallons per minute.

### QUALITY OF WATER FROM GLACIAL DRIFT

In general, the water from the glacial drift is high in total iron, total dissolved solids, and sulfates. The iron content in the water may cause staining of plumbing fixtures and laundry; however, relatively inexpensive water treatment for the iron will prevent this staining. For most types of irrigation, total dissolved solids should not exceed 2,000 parts per million and total alkalies should not exceed 75 percent. Most people cannot tolerate water for drinking purposes which contains more than 1,500 parts per million of chloride, or 2,000 parts per million sulfate. Water with 300 parts per million of chloride tastes salty to some people. Sulfates in excess of 500 parts per million may have a laxative effect when first used for drinking.

The following are analyses from five glacial drift wells, one of which is not shown on the accompanying map.

CONSTITUENTS	IN PARTS PER MILLION				
	1	2	3	4	5
Turbidity	Turbid	Turbid	Turbid	1.6	60
Odor	None	Stale	Stale		None
pH				7.9	7.1
Alkalinity (CaCO <sub>3</sub> )	222.1	244.9	281.7	84.0	231.5
Phenolphthalein				0	0.0
Methyl Orange				84.0	231.5
Carbonate (CO <sub>3</sub> )	0.0	0.0	1.3	0	0.0
Bicarbonate (HCO <sub>3</sub> )	270.9	298.7	342.5	102.4	282.4
Silica (SiO <sub>2</sub> )	3.2	15.2	19.2	0.0	15.5
Oxides (Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> , TiO <sub>2</sub> , etc.)	0.51*	2.29*	1.10*		4.5
Calcium (Ca)	119.8	85.4	87.6	44.6	447.8
Magnesium (Mg)	59.4	20.2	19.4	5.7	159.5
Sodium (Na) & Potassium (K) as Na	390.7	23.3	29.4	7.5	410.7
Total Manganese (Mn)	0.12				0.91
Total Iron (Fe)	5.20	1.20		0.04	6.80
Dissolved Iron	0.20		0.35		0.56
Precipitated Iron	5.00				6.24
Sulfate (SO <sub>4</sub> )	1160.8	91.4	73.0	45.2	2178.6

Chloride (Cl)	51.4	10.7	14.2	13.1	16.3
Nitrate (NO <sub>3</sub> )	0.63	0.0	0.25	2.22	0.2
Fluoride (F)	0.85				0.9
Total Suspended Matter	26.8				33.
Total Dissolved Solids	2089.0	433.0	467.0	217.0	3558.
Total Hardness	543.0	296.3	298.5	135.0	1774.7
Carbonate Hardness	222.1	244.9	281.7	84.0	231.5
Non-carbonate Hardness				51.0	1543.2
Percent of Alkalies	61	15	18	10	33

\* Al<sub>2</sub>O<sub>3</sub> only

1. Owner: E. C. Pettey, sec. 2, T. 64N., R. 22 W. Total depth 194 feet. Static water level 32 feet. Analyzed May 29, 1935 by R. T. Rolufs.

2. Owner: City of Milan, NE<sub>1/4</sub> SW<sub>1/4</sub> sec. 2, T. 62N., R. 20 W. Test hole 40 feet deep abandoned. Analyzed October 20, 1934 by R. T. Rolufs.

3. Owner: City of Milan, NE<sub>1/4</sub> SW<sub>1/4</sub> sec. 2, T. 62N., R. 20W. Total depth 80 feet. "Sample from second hole at Milan, water from 44 feet down. Water comes from quicksand 8 to 32 feet. Cased finally to 51 $\frac{1}{2}$  feet and all the water shut off." Analyzed October 20, 1934 by R. T. Rolufs.

4. Owner: Milan. Sample taken direct from clear well at plant June 13, 1955. Analyzed by Missouri Division of Health.

5. Owner: Humphreys School, NW<sub>1/4</sub> NE<sub>1/4</sub> SW<sub>1/4</sub> sec. 36, T. 62N., R. 22W. Total depth 165 feet; glacial drift to 135 feet. Water from hydrant after passing through pressure tank. Sampled October 2, 1956. Analyst: M. E. Phillips.

#### QUANTITY OF WATER FROM GLACIAL DRIFT

**DOMESTIC WELLS** - Included in this category are wells developed for household or general farm use. Yields required from domestic wells vary but seldom exceed 15 gallons per minute. In some parts of Sullivan County sands and gravels were not deposited in the glacial drift. There are also areas where the glacial drift cover is relatively thin or lacking. In such areas the possibility of developing wells is limited. Plate 1 shows the area most favorable for the development of domestic wells. Plate 3 is a contour map showing the elevation of bedrock above sea level. To determine probable drilling depths, the elevation of the bedrock should be subtracted from the

surface elevation for each specific site. Plate 3 shows the locations of the test holes and the thickness of the glacial drift encountered.

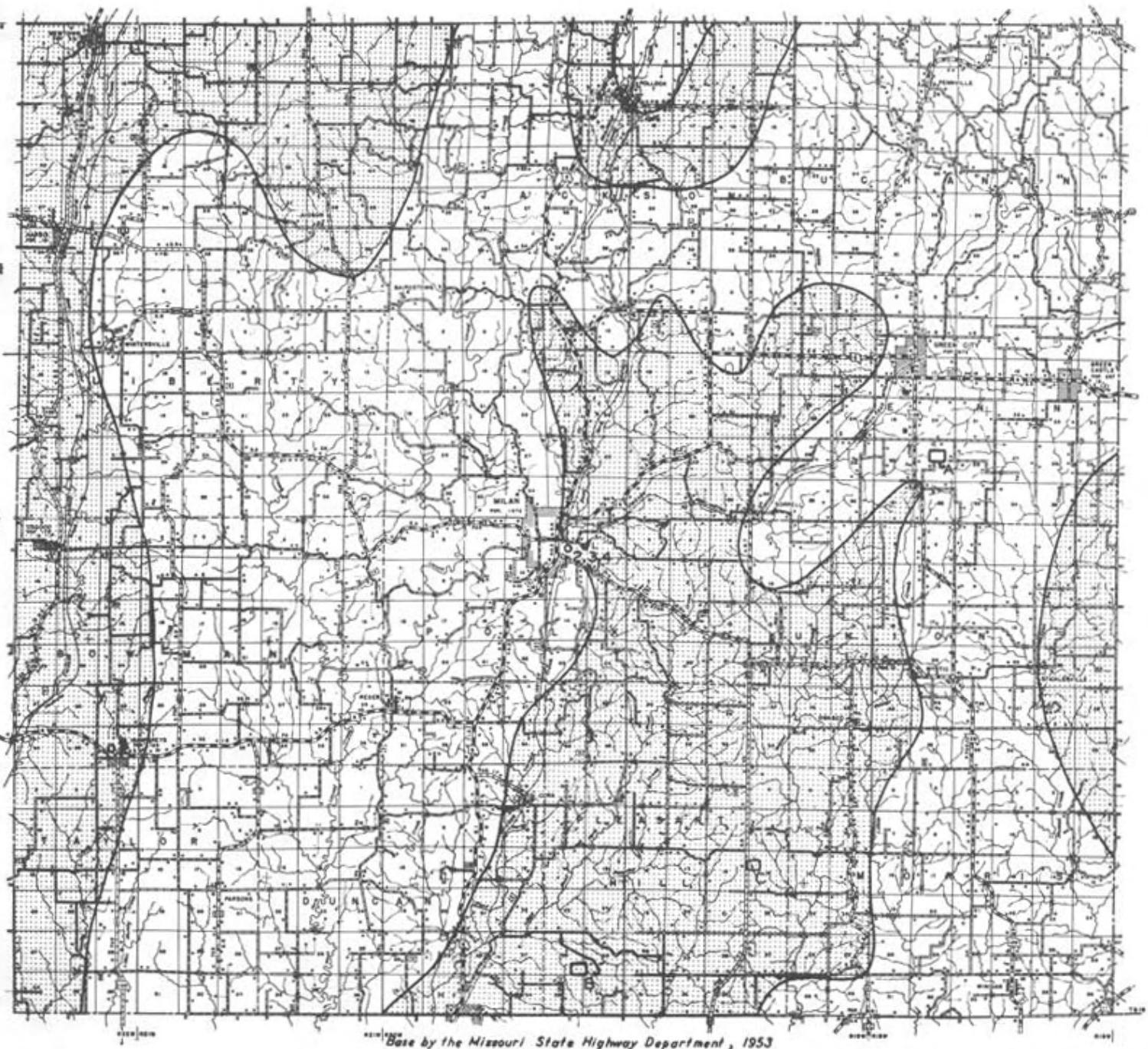
IRRIGATION WELLS - Included in this category are all high yield wells whether used by cities, by industries, or for irrigation. Plate 2 shows the area most favorable for the development of irrigation wells. Also shown are the locations of seven wells which flowed.

With proper development, yields of 200-1,000 gallons per minute may be obtained. Yields to be expected are contingent upon several factors:

- (1) The thickness of the sand and gravel beds.
- (2) The size and sorting of the sand and gravel.
- (3) The manner of construction and materials used, such as proper well screen, gravel pack, etc.
- (4) Ability of the well driller to develop the full capacity of the water bearing sands.

Continued successful production is contingent upon:

- (1) Re-charge rate of the water-bearing horizons.
- (2) Quality of the screen and materials used.
- (3) Subsequent well treatment such as acidizing.
- (4) Avoidance of over-pumpage.



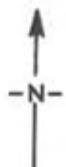
LEGEND



Area most favorable

$\circ_4$  Location of wells in drift from which water was analyzed

$\square_H$  Water sample analyzed from a 'rock' well



MAP OF SULLIVAN COUNTY  
SHOWING

AREA MOST FAVORABLE FOR THE  
DEVELOPMENT OF WELLS IN DRIFT

BY

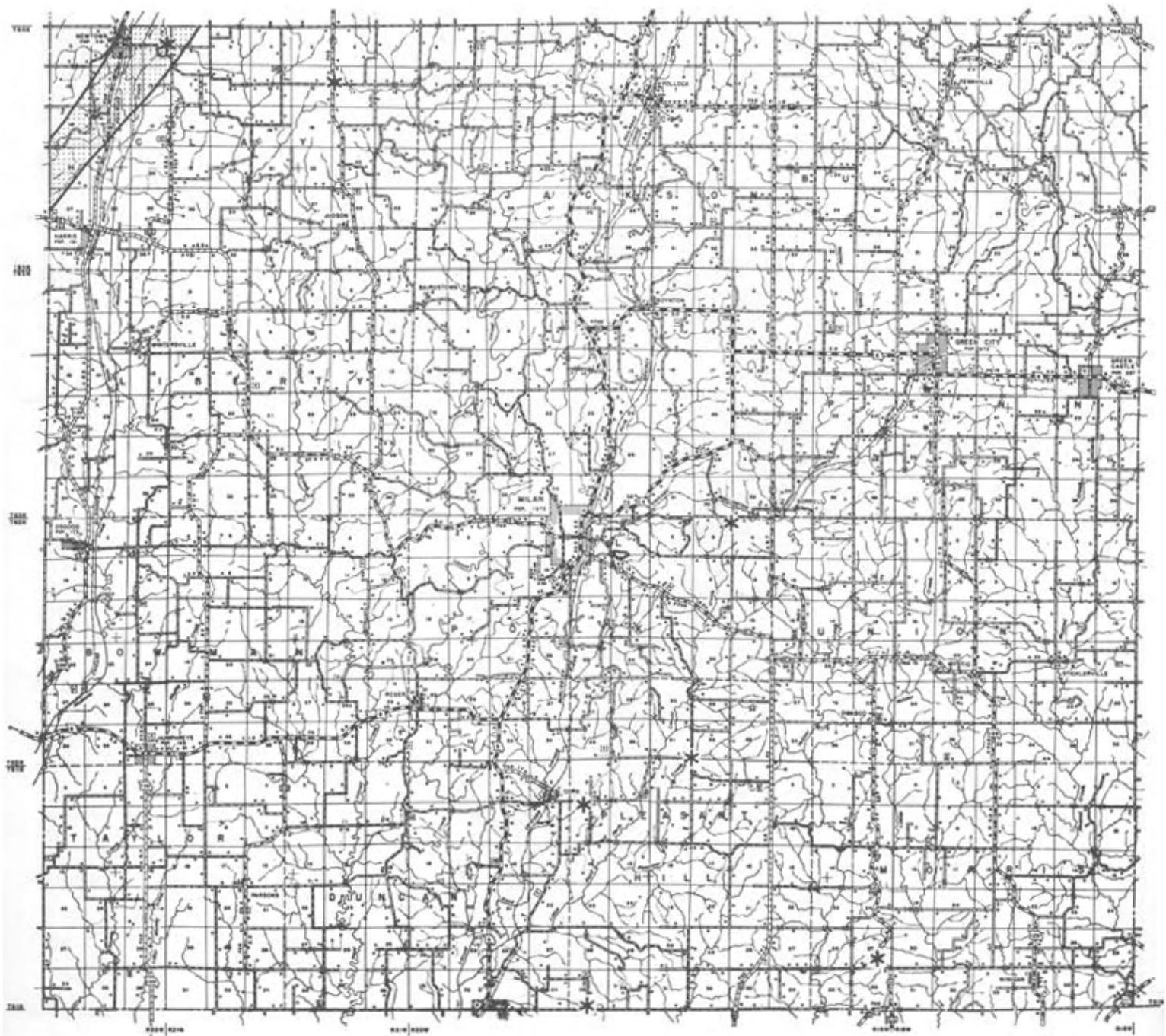
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ROLLA, MISSOURI

THOMAS R. BEVERIDGE  
STATE GEOLOGIST

PLATE I



Base by the Missouri State Highway Department, 1953

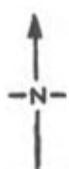
LEGEND



Drift filled valley



Test well that flowed



MAP OF SULLIVAN COUNTY

SHOWING

DRIFT FILLED VALLEYS IN WHICH  
IRRIGATION WELLS POSSIBLY CAN  
BE DEVELOPED

BY

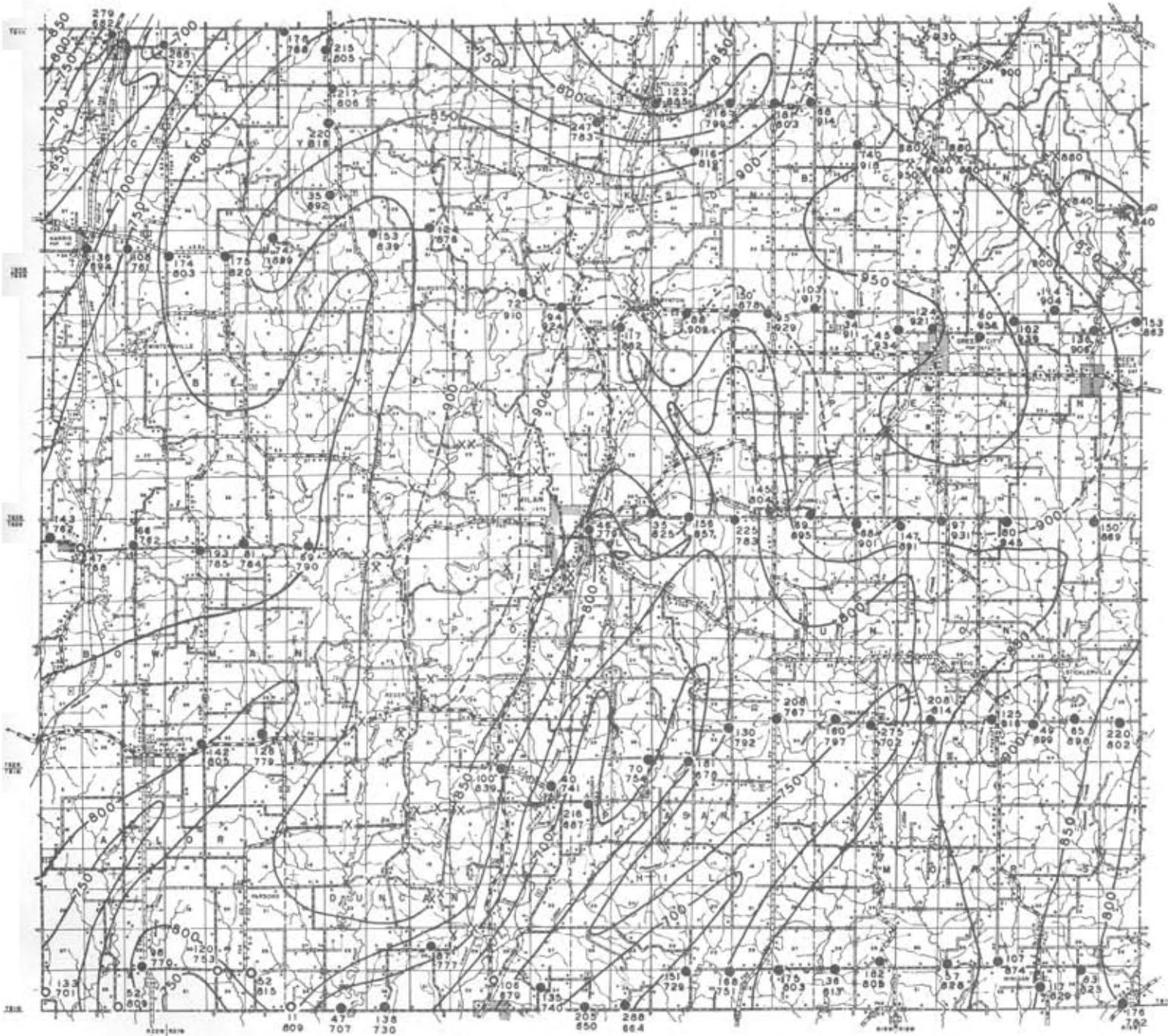
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MISSOURI GEOLOGICAL SURVEY  
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PLATE 2



Base by the Missouri State Highway Department, 1953

## LEGEND

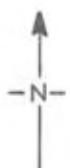
● 135 Test holes showing thickness in feet  
850 of drift and elevation of bedrock  
above sea level

○ Water wells

X Bedrock Outcrops

✗ Mine or Quarry

920 Indicates outcrop elevation



CONTOUR MAP  
OF  
SULLIVAN COUNTY  
SHOWING  
BEDROCK ELEVATIONS  
BY

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ROLLA, MISSOURI

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PLATE 3

## SUMMARY

Approximately 4,000 acres of Sullivan County are located within the area in which irrigation wells possibly can be developed. Approximately five-elevenths of Sullivan County's area is suitably located for obtaining water sufficient for domestic needs from the glacial drift.

Questions concerning water problems for a specific location should be sent to the Missouri Geological Survey, Rolla, Missouri 65401.